

Succulent plants from down under – The Kidney Fern (*Trichomanes reniforme*)

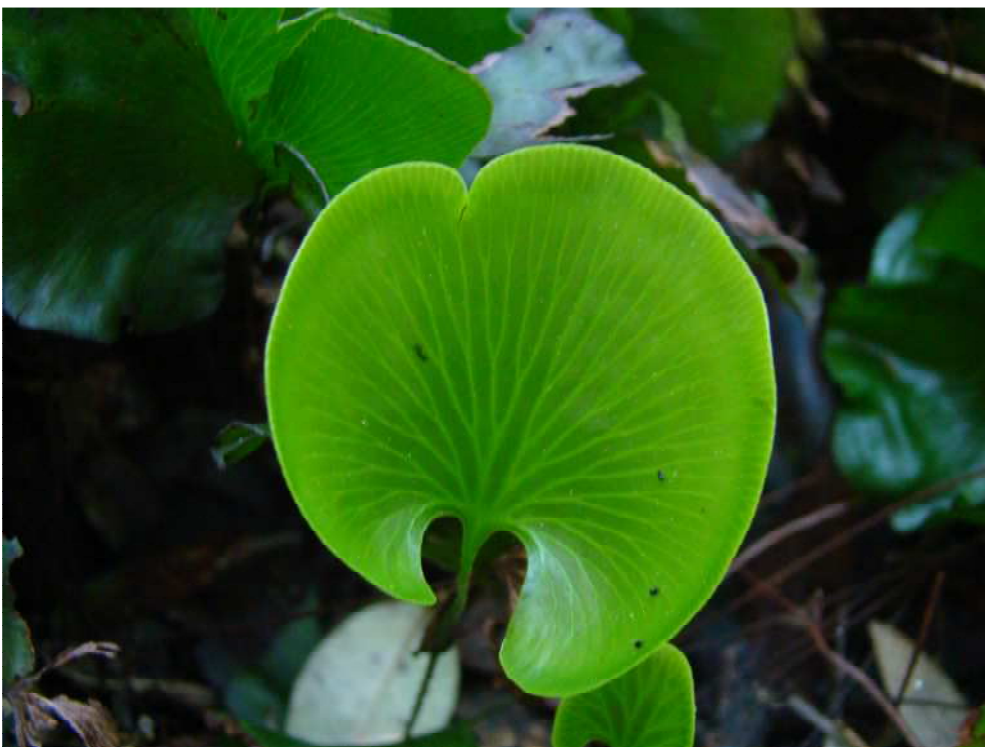
How strange this may sound for those who have just seen this plant but never gave too much attention the odd looking Kidney Fern - *Trichomanes reniforme* G. Förster 1786 – is indeed a true fern and not a misnomer. It was also known for a long time as *Cardiomanes reniforme* (G. Förster.) C. Presl 1843 (1) and belongs to the sub-cosmopolite *Hymenophyllaceae* (2) family; it is not only native, but endemic to New Zealand. More, you may find very strange that I have decided to write about this plant in this series dedicated to the succulent plants – native or alien – growing in New Zealand. But is it a succulent plant?

Trichomanes reniforme is a far-creeping much-branched rhizomatous plant with tufts of dark red-brown hairs at the base of the rather distant to approximate stipites (3). These are stout and 5 – 20 cm long although the plant does rarely exceed 10 cm in height and not winged. The fronds (4) have 3 – 10 x (4) 5 – 10 (13) cm and are translucent when hydrated making their forking veins very visible. In their mature state they have a very distinctive reniforme shape (5) and are shallowly sinuate, while juvenile fronds are divided above. Being a fern of course it does not flower but has sexual reproduction organs called sori (6) set often very closely along the margins, the indusium is ca. 2 mm long and cup to almost bell-shaped.



1. Patches of *Trichomanes reniforme* form a dense ground cover in Kidney Cove Glenn (Rangitoto Island).

The Kidney Fern belongs to a distinct type of ferns, maybe less known to the public - the filmy ferns - placed in the *Hymenophyllaceae* family and subject of merging and splitting in the past and apparently still debated; however, I will leave to botanists to agree upon including *Cardiomanes* as a subgenera in *Trichomanes* or maintaining as a stand alone genus or agree upon recent proposed recombinations within *Trichomanes*. These filmy ferns are quite common in many parts of the world (there are some 600 odd species spread mostly in tropical rainforests but also in temperate rainforests as is the case in New Zealand) and have a peculiar appearance, forming usually “*very dark green or even black clumps and may be mistaken for a robust moss or liverwort*” (Wikipedia). They usually prefer damp places with more or less continuously mist coming from water falls or springs or simply enjoying the moist conditions existing in many rain forests. They are relics from a primitive flora that was dominant in old geological times when the climate was not necessarily cooler, but definitely moister, long before continental drift, mountain raise and desertification processes have shaped the earth as we know it today. Fossil discoveries have proven that filmy ferns have existed at least since the Upper Triassic (7).

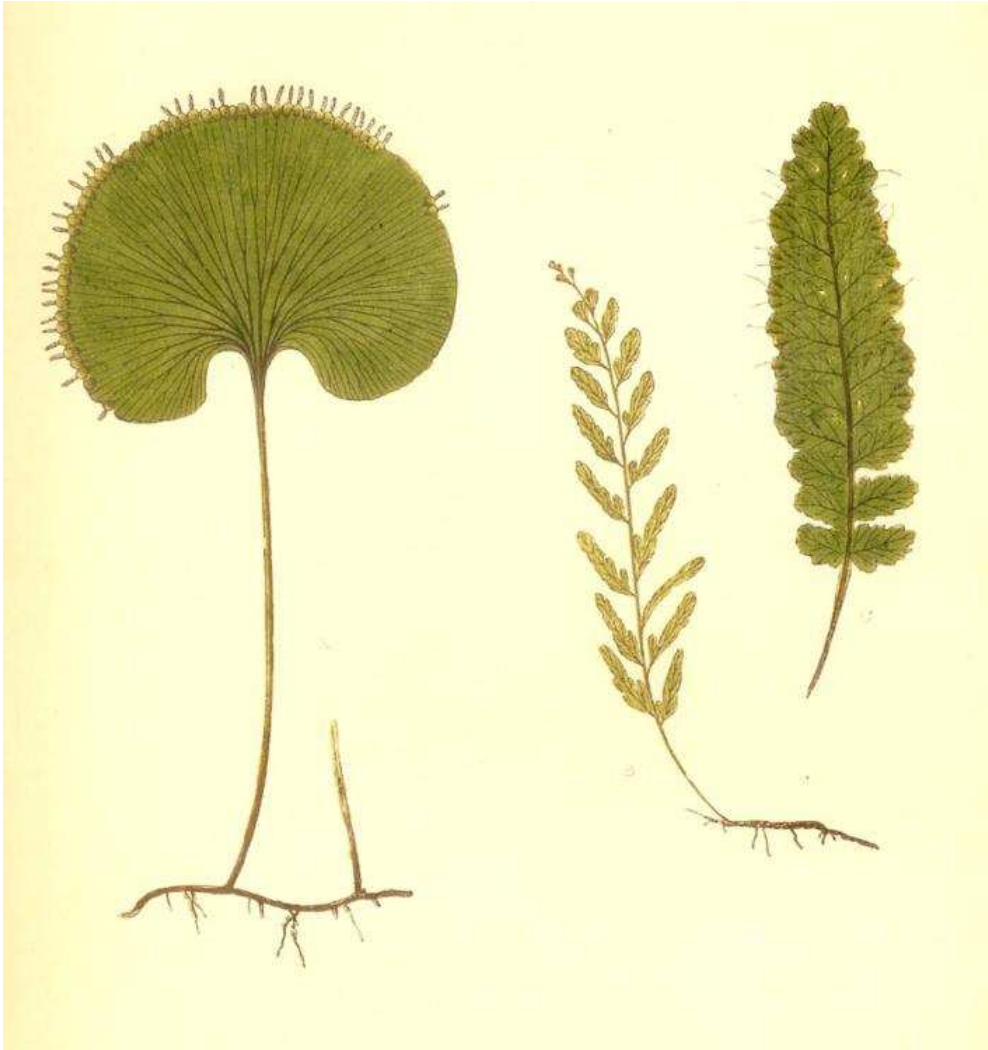


2. The frond of *Trichomanes reniforme* – picture taken in Kidney Fern Glen (Rangitoto Island) in late winter.

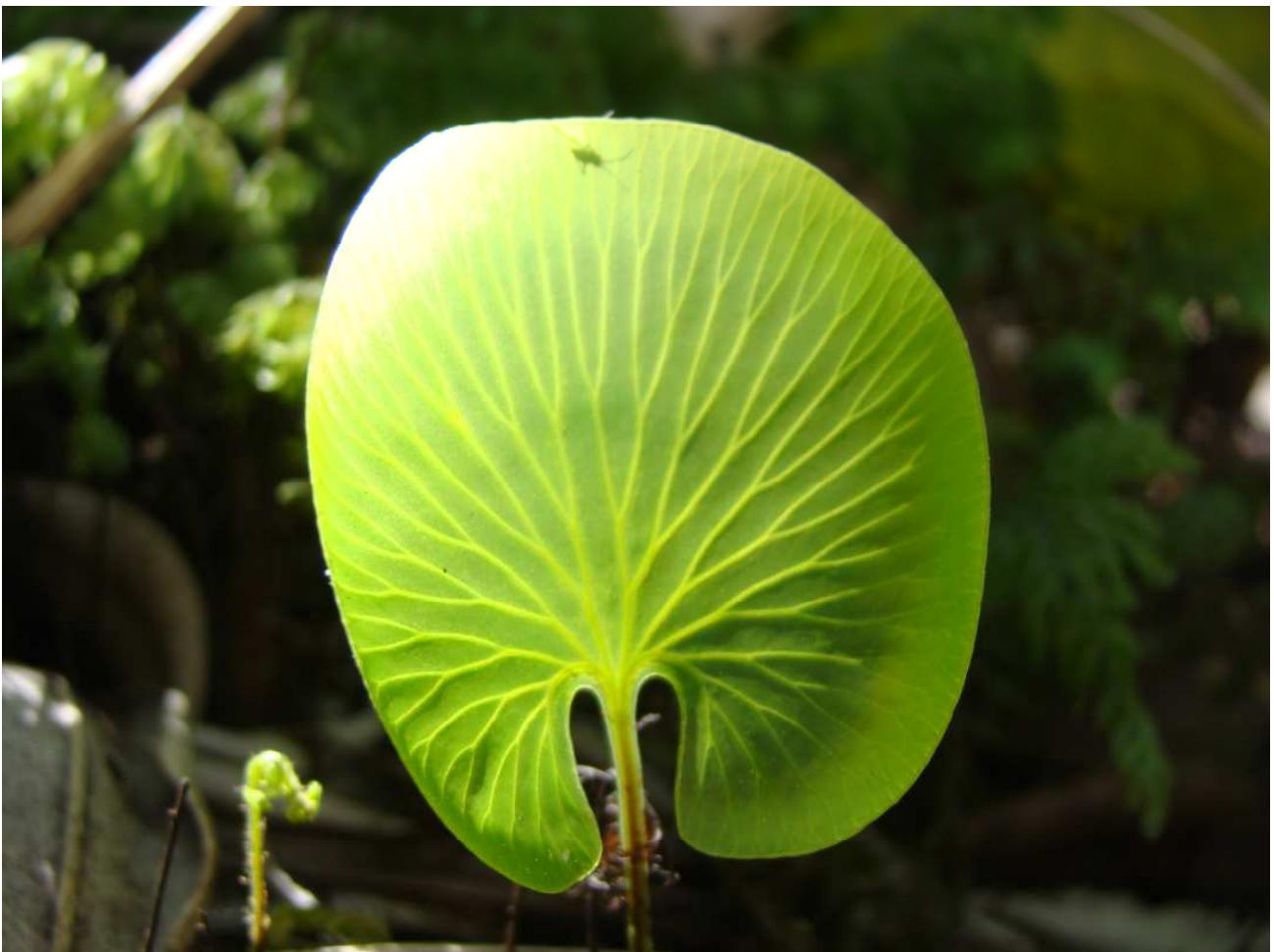
Our New Zealand endemic *Trichomanes reniforme* is a bit different although I wouldn't say it is altogether untypical for this plant group. As expected the design of the filmy ferns allows survival in moist environments where almost constant water supply is no issue. “*In most species, the frond, apart from the vascular tissue, is only a single cell thickness, and they do not have any stomata; this makes the plants very susceptible to desiccation (...)*” (Wikipedia). In other words this makes them fairly unfit for dryer habitats as they fully depend on a “*specialization to a hygrophilous habit*” although specialization and derivative characters wouldn't match the view that the entire family has to be regarded “*relatively primitive*” as John E. Holloway (1944) ambiguously considers. Without stomata – organs that by opening / closing in certain conditions can regulate the water loss – all exchanges are membranous and this implies comparatively huge amounts of water being available to keep the ball rolling. However, some of the filmy ferns – and *Trichomanes reniforme* is a typical example – have developed a simple morphological improvement: instead of one single layer of cells the fronds are 4 to 6 cells in thickness, placed below and above a central much stronger cell layer. This may look very

petty for the entire economy of the plant, fact is that this alone allows the Kidney Fern to store enough moisture in its fronds in order to pass more or less prolonged periods of draught or simply evade the moist habitat restrictions and adventure in otherwise unthinkable places like the aa lava flows (8) of Rangitoto; but about its ecology we will speak a bit later. Fact is that we deal here with a primitive succulent tissue, functional and efficient enough to allow us to consider this plant having a marginal succulent character or sub-succulence in botanical English. During rainy or wet winter periods the fronds take up as much water as possible (they become visible succulent and translucent against the light) only to curl up and dry out in summer reversing to a papery state (the withered fronds look like parchment). However, the fronds readily recover after significant rain falls. It would be too much said that it displays a xerophytic character as there is no significant mechanism or morphological adaptation towards reducing water loss in place; however, the plant has found a very effective solution to overcome fairly dry periods by increasing its succulence paralleled by a higher water intake speed when moisture is available. On the other hand this is far from being a perfect mechanism during extreme dry and hot summers, in this instance all aerial parts of the plant will die back leaving only subterranean parts alive. Nevertheless I have seen toward the end of some of the driest and hottest summers on record (2007, 2008) plants with fairly good hydrated fronds, anyway far from being write-offs. The hygrophytic *Trichomanes reniforme* has managed to survive as a whole (and not only the underground parts) in such a hostile environment!

3. "British ferns"- by E.J. Lowe (1860), a hand coloured wood engraving picturing *Trichomanes reniforme*, *Trichomanes venosum* and *Trichomanes bancroftii*.



Being a true ferns *Trichomanes reniforme* has retained the specific propagation method by spores. However, fertilization occurs only in moist conditions, which is actually a simple but very effective sample of physiologic plasticity in primitive plants. It doesn't make any sense for the plant to produce and send out spores in an unfriendly environment, but rather wait until moisture is freely available. In a typical situation water comes of course from above – and this is the moment fertilization occurs. John E. Holloway (1944) has cultivated for experimental purposes *Trichomanes reniforme* in cultures watered only from below up to the age of 3 ½ years and observed that “fertilization was clearly thereby prevented, up to this point no embryos being observed, although both kinds of sex organs had been present on the ribbons for 12 months. At this stage of the culture the gametophytes were watered several times from above by thorough pipetting in order to induce fertilization, with the result that it took place copiously. Within two months embryos were present in abundance.”



4. Good hydrated fronds are translucent – plant from Kidney Fern Glen (Rangitoto).

Another important feature in *Trichomanes reniforme* is the marginal rib of the fronds, present in mature fronds only where sori are absent but being continuously in sterile fronds. It is actually a very “well-defined cuticle (9) over the rib surface, the lamina cuticle being more delicate even in old fronds. The lamina is several-layered up to the rib, the number of layers finally becoming four by the subdivision of the central large-celled layer.” As *Trichomanes reniforme* occurs on occasion in relatively exposed situations this rib is an extremely important feature as it prevents the tearing off of the extremely

delicate lamina by winds. In dry conditions, when the lamina becomes even more fragile, the rib allows an inward rolling from both sides drastically reducing its exposure to wind and direct sun.



5. New frond and old fronds with sori (clusters of spore bearing organs) – plant from Kidney Fern Glen (Rangitoto).



6. Epiphytic growing *Trichomanes reniforme* – plants from Kidney Fern Glen (Rangitoto).

However, even if in the embryogeny of *Trichomanes reniforme* “primitive features are especially in evidence” (John E. Holloway, 1944) but “at the same time it has developed specialized frond characters that enable it to withstand drier conditions than those usual for the family, these characters having developed in a frond that at an earlier period showed the same type of specialization in frond-lamina structure as has the family as a whole.” Despite its primitivism this plant has definitely placed a bid for succulence as derivative character helping to gap drier periods. Succulence becomes therefore not a typical characteristic of evolved plants, but a general feature of the entire regnum as the direct result of phenotypic plasticity in certain circumstances. In this instance it looks more like a process that has been started but in the end suspended halfway through.

Trichomanes reniforme has a particular ecology, somewhat different from most of the ferns. Even if it prefers permanently moist environments it is definitely not limited to these. It occurs throughout New Zealand, Stuart Island and Chatham Islands and is a New Zealand endemic plant. It typically grows in coastlands to lowlands to sub-montane forests, but also occurs on boulders, rock falls, cliff faces and in some shrub land, even on lava flows, but always prefers an early stage succession forest and is less comfortable in dense well established forests and even less in monotypic pine plantations. The wet Westland is probably home for the most extensive populations, as a sub-canopy ground cover among other ferns like *Blechnum discolor*, but is fairly common in other parts of New Zealand as well.



7. *Trichomanes reniforme* in high summer on the path to Wreck Bay (Rangitoto) – still good hydrated.

Rangitoto Island is one of the less typical habitats. The Kidney Fern occurs mostly in association with *Metrosideros* scrub in a transitional vegetation stage between open lava flows and *Metrosideros* forest, becoming also less abundant in places where *Astelia* spp. or *Myrsine australe* become increasingly frequent (which is actually a late vegetation succession stage as well). In fact several successional

pathways can be linked to the *Trichomanes reniforme* ground cover but one thing is sure – it grows mainly on aa lava flows and less on slab lava flows. In some places it grows quite abundantly (Kidney Fern Glen or halfway on the path to Wreck Bay) even if the available moisture levels differ – fairly moist most of the year in the grooves of the first location and rather dryish in the second, however, mostly on the southern edges of the vegetation islands.

Trichomanes reniforme is rarely available in nurseries, other than choice native ferns propagation units, and seem to be rather difficult in cultivation. It is also virtually impossible for the average enthusiast to keep alive plants collected from nature and this is the main reason why – even if not threatened – it is highly recommended not to collect this plant.



8. *Trichomanes reniforme* in high summer on the path to Wreck Bay (Rangitoto) – fronds are rolled inwards from both sides reducing the exposure to wind and direct sun.



9. A moist and rather dark bush is the typical habitat of *Trichomanes reniforme* - Kidney Fern Glen (Rangitoto).

Being not very interested in rain forests I didn't have the chance to observe this plant in its typical habitat. However, it is quite common in several parts of Rangitoto, usually at bush margins, where I have seen this plant both in high summer and in late winter. The main concentration of plants is in Kidney Fern Glen, a slightly sloping *Metrosideros* dominated bush with southern exposure, only few minutes from Rangitoto wharf. You will love this place! Walking the winding path uphill to join the Summit Track makes you feel like living in a fairy tale.

References:

H. H. Allen – Flora of New Zealand (The updated electronic version, Vol. 1, 2004 - <http://floraseries.landcareresearch.co.nz>);

<http://www.hiddenforest.co.nz/plants/trueferns/trueferns.htm>;

John E. Holloway – The Gametophyte, Embryo and Developing Sporophyte of *Cardiomanes reniforme* (Transactions of the Royal Society of New Zealand, vol. 74, 1944);

Andrea Julian - The vegetation pattern of Rangitoto (1992);

New Zealand Plant Conservation Network (2009) (www.nzpcn.org.nz);

Wikipedia, the free encyclopedia.

Further Readings:

L. Cockayne - Observations concerning Evolution derived from Ecological Studies in New Zealand (1911) - in Transactions of the New Zealand Institute.

My Notes:

(1) This name is still accepted by several authorities while *Cardiomanes* is considered the most likely candidate to be accepted as a stand alone genus, than for all other subgenera of *Trichomanes*. Plants now included in *Trichomanes* used to be placed in several other genera. Another synonym is *Hymenophyllum nephrophyllum* (G. Förster) Ebihara & K. Iwatsuki 2006.

(2) The family of the filmy ferns – *Hymenophyllaceae* – was subject of many changes during the last century or so, the accepted names within this family varying in time between 7 and 34. Ebihara & K. Iwatsuki have recently performed a new revision of this family recombining *Trichomanes reniforme* into *Hymenophyllum*. But as the name *Hymenophyllum reniforme* was already used another name - *Hymenophyllum nephrophyllum* - was used instead, with the potential to create some confusion. On the other hand their recombination has some historic support. In 1944 Holloway was already considering that *Cardiomanes reniforme* (as the accepted name of this plant was at that time) has more affinities with *Hymenophyllum* rather than *Trichomanes*. By merging several genera into *Trichomanes* (including some of the ferns formerly included in *Cardiomanes*) this genus became increasingly composite. Ebihara and K. Iwatsuki have recently split *Trichomanes* sensu lato because of its polyphyletic origins. I have used the more known name *Trichomanes reniforme* in this article but I am aware of the fact that their recombination might gain very soon general acceptance.

(3) Stipes (plural being stípites) has different meanings even if circumscribed only to biology, the strict botanical meaning is a stalk-like supporting structure.

(4) Fronds are compound leaves of ferns, palms or cycads.

(5) Reniform means kidney shaped – hence the English common name. Other Maori vernaculars are Raurenga, Konehu and Kopakopa.

(6) A sorus (plural being sori) is (in fungi, lichens, algae and in ferns) a cluster of sporangia, a spores producing specialized organ.

(7) The Upper Triassic (or Late Triassic) is the latest epoch of the Triassic period of geologic time, beginning about 200 million years ago. The Late Triassic is divided into the Carnian, Norian and Rhaetian ages. Of course this is boring stuff, pretty much uninteresting for most of the readers, but I just add to this that many of the earliest dinosaurs have evolved during this geologic epoch and I trust I will regain your attention. Guaranteed!

(8) Andrea Julian, 1992: "The physical variation of the lava flows is an expression of the physical state of the molten lava, being a function of both the viscosity and the rate of shear strain (...).When the lava reaches a certain combination of viscosity and shear strain rate, aa flows will be produced. (...) Aa lava flows are characterized by a rough and clinkery surface. The clinker fragments are formed largely as a result of the reworking of the semi-solid surface of the slowly-moving, viscous aa lava flow. On the surface of each aa lava flow, the fragments are loose, but below the surface they have often become welded together, having been sufficiently molten to re-fuse when the flow stopped moving. Despite their fragmentary appearance, generally less than 50% of an aa flow is made up of fragments (...). The inner core of aa flows consists of solid rock, which is normally completely covered by a varying depth of clinker; from a few tens of centimeters to 2 to 3 meters (...)." The slab flows form "as a result of an increase in viscosity in the liquid lava flowing beneath the solid crust, causing the liquid to exert a greater drag on the crust. Macdonald (1972) rather picturesquely describes the breaking and tilting of the slabs as being like 'floes in an ice-jammed river'."

(9) A cuticle (or cuticula) is any type of tough but flexible non-mineral outer cover of an organism or part of an organism, which provides protection. Cuticles may differ in their origin, structure, physical properties or chemical composition.

All errors, omissions and misconceptions are mine.

Eduart Zimer, March 2010

<http://eduart.page.tl/Home.htm>